

147423



Stream Bioassessment

Bound Brook, New Jersey

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Participating Personnel:

U.S. Environmental Protection Agency
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Report Prepared by:

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Stream: Bound Brook (South Plainfield to Middlesex)

Objective:

Biological sampling using rapid bioassessment procedures, which utilizes benthic macroinvertebrate communities to screen water quality, was conducted at three locations on Bound Brook on June 12, 1992. Macroinvertebrate samples were taken in riffle areas using the kick net procedures described in appendix i. Organisms and debris collected were placed in one quart sample jars containing alcohol and preserved for lab processing as outlined in appendix I. All macroinvertebrates were identified to the family level, with the exception of oligochaeta (worms) and gastropoda (snails). All organism identifications and counts were recorded for each station. Water quality was evaluated using the following community measures: 1) total taxa richness, 2) EPT richness, 3) percent dominance, 4) percent EPT and 5) biotic index (See appendices II and III). Physical and chemical measurements for existing stream conditions were recorded on physical characterization/water quality field data sheets. Stream habitat condition was recorded on habitat assessment field sheets.

Findings and Conclusions:

Water quality was assessed as severely impacted at station 1 and moderately impacted at stations 2 and 3. All five biological metrics used to assess the macroinvertebrate community at station 1 measured gross impairment. An increase in taxa richness was responsible for the slightly improved biological condition measured at both downstream locations. An impoundment located between stations 1 and 2 may serve as a trap for the downstream release of pollutants. This may be implicated as one reason for the slight water quality improvement. Additional studies using fish community assessments have also measured poor to fair water quality in Bound Brook.

Recommendations:

Intensive basin assessments utilizing biological and chemical parameters should be conducted to determine the pollutants responsible for the serious water quality degradation.

station 1: Upstream of Lakeview Ave

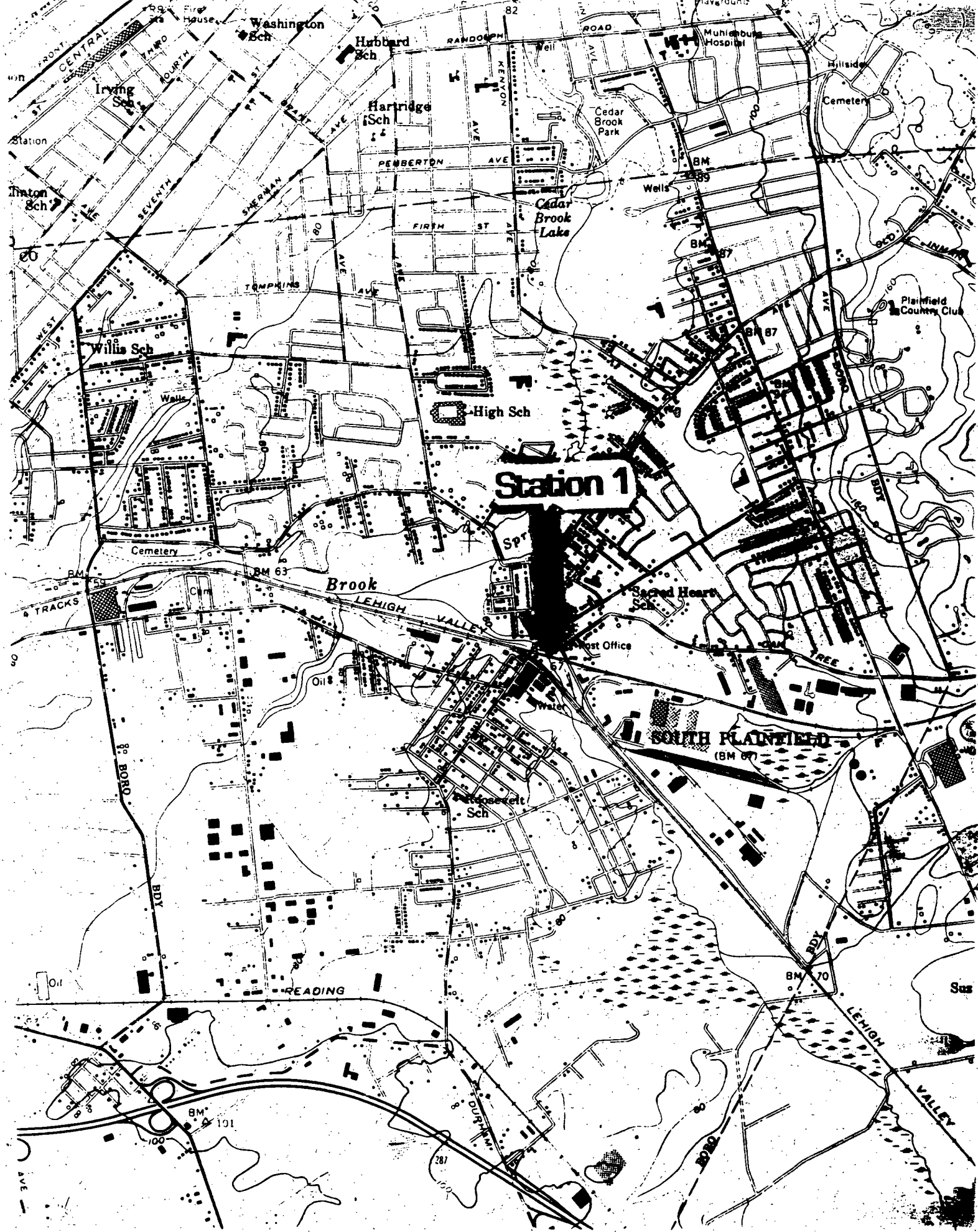
Total taxa richness: 2 (severely impacted)
EPT richness: 0 (severely impacted)
Percent dominance: 97 (severely impacted)
Percent EPT: 0 (severely impacted)
Biotic index: 7.94 (severely impacted)
Water Quality Assessment: severely impacted

Station 2: Downstream of Prospect Ave

Total taxa richness: 7 (moderately impacted)
EPT richness: 1 (severely impacted)
Percent dominance: 51 (moderately impacted)
Percent EPT: 0 (severely impacted)
Biotic index: 5.44 (moderately impacted)
Water Quality Assessment: moderately impacted

Station 3: Upstream of Hwy 28

Total taxa richness: 7 (moderately impacted)
EPT richness: 1 (severely impacted)
Percent dominance: 34 (non-impacted)
Percent EPT: 0 (severely impacted)
Biotic index: 6.31 (severely impacted)
Water Quality Assessment: moderately impacted



Station 3

Station 2



1990

Water Body Bound Brook Station No. 1 Grab No. Lab No. 3
Sample Date 6-12-92 Sampling Instrument Kick Net Taxa No. 2
Organism No. 100 Sorted By M. Chioduck Identified By J. Kauterbach 10-22-92

		T*	Total			T*	Total
DIPTERA				ODONATA			
Chironomidae III		6	3				
				COLEOPTERA			
				OTHER INSECTA			
PLECOPTERA							
				HIRUDINEA			
				OLIGOCHAETA		8	97
TRICHOPTERA							
				AMPHIPODA			
				DECAPODA			
EPHEMEROPTERA							
				ISOPODA			
				GASTROPODA			
				PELECYPODA			
COMMUNITY METRICS			Score	OTHER			
Total Families	2	0					
EPT Families	0	0					
Percent Dominance	97	0					
Percent EPT	0	0		Biological Condition		Total Score	
Hilsenhoff Biotic Index	7.94	0		Severely Impacted		0	

T* - Biotic Index Tolerance Value

MACROINVERTEBRATE DATA

Water Body Board Creek Station No. 2 Grab No. 2 Lab No. 2
 Sample Date 6-12-92 Sampling Instrument Kick Net Taxa No. 7
 Organism No. 104 Sorted By M. Chadwick Identified By J. Kurtzsch 10-26-92

	T*	Total		T*	Total
DIPTERA			ODONATA		
Chironomidae 	6	8			
			COLEOPTERA		
			OTHER INSECTA		
PLECOPTERA					
			HIRDDINEA		
			OLIGOCHAETA 	8	8
TRICHOPTERA					
Hydropsychidae 	4	8			
			AMPHIPODA		
			Gammaridae 	4	53
			DECAPODA		
EPHEMEROPTERA					
			ISOPODA		
			Acetabularia 	8	12
			GASTROPODA 	7	6
			PELECYPODA		
			Sphaeriidae 	8	9
COMMUNITY METRICS		Score	OTHER		
Total Families	7	3			
EPT Families	1	0			
Percent Dominance	51	3			
Percent EPT	0	0	Biological Condition	Total Score	
Hilsenhoff Biotic Index	5.44	3	Moderately Impacted	9	

T* - Biotic Index Tolerance Value

MACROINVERTEBRATE DATA

Water Body Bound Brook Station No. 3 Grab No. Lab No. 9
 Sample Date 6-12-92 Sampling Instrument Kick Net Taxa No. 7
 Organism No. 100 Sorted By M. Chadwick Identified By J. Kuntzbach 10-26-92

	T*	Total		T*	Total
DIPTERA			ODONATA		
<i>Chironomidae</i> IIII	6	8			
			COLEOPTERA		
			OTHER INSECTA		
PLECOPTERA					
			HIRUDINEA		
			OLIGOCHAETA IIII IIII IIII IIII IIII	8	29
TRICHOPTERA					
<i>Hydropsychidae</i> IIII	4	4			
			AMPHIPODA		
			<i>Gammaridae</i> IIII IIII IIII IIII IIII IIII	4	34
			DECAPODA		
EPHEMEROPTERA					
			ISOPODA		
			<i>Asellidae</i> IIII IIII IIII IIII IIII	8	23
			GASTROPODA 1	7	1
			PELECYPODA		
			<i>Sphaeriidae</i> 1	8	1
COMMUNITY METRICS		Score	OTHER		
Total Families	7	3			
EPT Families	1	0			
Percent Dominance	34	6			
Percent EPT	0	0	Biological Condition	Total Score	
Hilsenhoff Biotic Index	6.3	0	Moderately Impacted	9	

T* - Biotic Index Tolerance Value

Field Data Summary Sheet

Stream Name: Bound Brook Station #: 1
County: Middlesex State: NJ
Location: Ds Lakeview Ave. Investigators: J. Kurtenbach
Date: 6-12-92 M. Chadwick
Time: 9:30 am Affiliation: U.S.E.P.A.

Physical Characteristics

Land Use: Forest/Com./Ind. Velocity: 1.6 ft/sec
Stream Width: 23' Canopy Cover: Partly Open
Riffle Depth: 6" Sediment Deposits: Sand/silt
Run Depth: Undersides embedded ***
Pool Depth: stones not black: ---
Dam Present: No Channelized: No

Substrate	% Comp.	Organic Substrate	% Comp.
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Bedrock		Detritus	
Boulder	30%	Muck-Mud	
Cobble	40%	Marl	
Gravel	15%		
Sand	15%		
Silt			
Clay			

Water Quality

Temperature: 19 C
Conductivity: 390 umhos/cm
pH: 7.1
Dissolved Oxygen: 5.0 ppm
Stream Type: Warmwater
Water Odor: None
Surface Oils: Flecks
Turbidity: Turbid
Free Available Cl: ---
Ammonia Nitrogen: 0.4 ppm

Weather Conditions:

Sunny - 80's

Other Observations:

No fish observed

HABITAT ASSESSMENT FIELD SHEET *

Stat 1

Category/Parameter	Condition			
	Excellent	Good	Fair	Poor
PRIMARY--SUBSTRATE AND INSTREAM COVER				
1. bottom substrate and available cover	11 16-20	11-15	6-10	0-5
2. embeddedness	12 16-20	11-15	6-10	0-5
3. flow/velocity	15 16-20	11-15	6-10	0-5
SECONDARY--CHANNEL MORPHOLOGY				
4. channel alteration	9 12-15	8-11	4-7	0-3
5. bottom scouring and deposition	9 12-15	8-11	4-7	0-3
6. pool/riffle, run/bend ratio	9 12-15	8-11	4-7	0-3
TERTIARY--RIPARIAN AND BANK STRUCTURE				
7. bank stability	8 9-10	6-8	3-5	0-2
8. bank vegetation	9 9-10	6-8	3-5	0-2
9. streamside cover	8 9-10	6-8	3-5	0-2
Total Score				

90

Condition:

Excellent	111 - 135
Good	75 - 102
Fair	39 - 66
Poor	0 - 30

* Taken from Plafkin et. al. 1988.

Field Data Summary Sheet

Stream Name: Bound Brook Station #: 2
County: Middlesex State: NJ
Location: Ds Prospect Ave. Investigators: J. Kurtenbach
Date: 6-12-92 M. Chadwick
Time: 10:50 am Affiliation: U.S.E.P.A.

Physical Characteristics

Land Use: Residential/Commercial Velocity: 1.5 ft/sec
Stream Width: 20' Canopy Cover: Partly Open
Riffle Depth: 9" Sediment Deposits: Sand
Run Depth: Undersides embedded ***
Pool Depth: stones not black: Yes
Dam Present: Yes Channelized: No

Substrate	% Comp.	Organic Substrate	% Comp.
Bedrock		Detritus	
Boulder	30%	Muck-Mud	
Cobble	40%	Marl	
Gravel	15%		
Sand	15%		
Silt			
Clay			

Water Quality

Temperature: 22 C
Conductivity: 350 umhos/cm
pH: 7.1
Dissolved Oxygen: 5.0 ppm
Stream Type: Warmwater
Water Odor: None
Surface Oils: None
Turbidity: Turbid
Free Available Cl: ---
Ammonia Nitrogen: 0.14 ppm

Weather Conditions:
Sunny - 80's

Other Observations:
Fish & crayfish observed
Substrate with algal slime & fine silt

HABITAT ASSESSMENT FIELD SHEET *

5422

Category/Parameter	Condition			
	Excellent	Good	Fair	Poor
PRIMARY--SUBSTRATE AND INSTREAM COVER				
1. bottom substrate and available cover	13 16-20	11-15	6-10	0-5
2. embeddedness	11 16-20	11-15	6-10	0-5
3. flow/velocity	15 16-20	11-15	6-10	0-5
SECONDARY--CHANNEL MORPHOLOGY				
4. channel alteration	8 12-15	8-11	4-7	0-3
5. bottom scouring and deposition	8 12-15	8-11	4-7	0-3
6. pool/riffle, run/bend ratio	7 12-15	8-11	4-7	0-3
TERTIARY--RIPARIAN AND BANK STRUCTURE				
7. bank stability	8 9-10	6-8	3-5	0-2
8. bank vegetation	9 9-10	6-8	3-5	0-2
9. streamside cover	8 9-10	6-8	3-5	0-2
	—	—	—	—

Total Score 87

Condition:

Excellent	111 - 135
Good	75 - 102
Fair	39 - 66
Poor	0 - 30

* Taken from Plafkin et. al. 1988.

Field Data Summary Sheet

Stream Name: Bound Brook Station #: 3
County: Middlesex State: NJ
Location: Us Hwy 28 bridge Investigators: J. Kurtenbach
Date: 6-12-92 M. Chadwick
Time: 12:05 pm Affiliation: U.S.E.P.A.

Physical Characteristics

Land Use: Residential/Commercial Velocity: 1.2 ft/sec
Stream Width: 45' Canopy Cover: Partly Open
Riffle Depth: 7" Sediment Deposits: Sand
Run Depth: Undersides embedded ***
Pool Depth: stones not black: Yes
Dam Present: No Channelized: No

Substrate	% Comp.	Organic Substrate	% Comp.
Bedrock		Detritus	
Boulder	20%	Muck-Mud	
Cobble	30%	Marl	
Gravel	25%		
Sand	25%		
Silt			
Clay			

Water Quality

Temperature: 22 C
Conductivity: 310 umhos/cm
pH: 6.9
Dissolved Oxygen: 5.0 ppm
Stream Type: Warmwater
Water Qdor: None
Surface Oils: None
Turbidity: Slightly turbid
Free Available Cl: ---
Ammonia Nitrogen: 0.2 ppm

Weather Conditions:
Sunny - 80's

Other Observations:
Fish & crayfish observed
Substrate with algal slime & fine silt
Pbndweed.waterweed & water milfoil common

HABITAT ASSESSMENT FIELD SHEET *

Stat. 3

Category/Parameter	Condition			
	Excellent	Good	Fair	Poor
PRIMARY--SUBSTRATE AND INSTREAM COVER				
1. bottom substrate and available cover	10 16-20	11-15	6-10	0-5
2. embeddedness	11 16-20	11-15	6-10	0-5
3. flow/velocity	14 16-20	11-15	6-10	0-5
SECONDARY--CHANNEL MORPHOLOGY				
4. channel alteration	7 12-15	8-11	4-7	0-3
5. bottom scouring and deposition	7 12-15	8-11	4-7	0-3
6. pool/riffle, run/bend ratio	6 12-15	8-11	4-7	0-3
TERTIARY--RIPARIAN AND BANK STRUCTURE				
7. bank stability	7 9-10	6-8	3-5	0-2
8. bank vegetation	9 9-10	6-8	3-5	0-2
9. streamside cover	8 9-10	6-8	3-5	0-2
	—	—	—	—

Total Score 79

Condition:

Excellent	111 - 135
Good	75 - 102
Fair	39 - 66
Poor	0 - 30

* Taken from Plafkin et. al. 1988.

APPENDIX I

Field Collection:

Riffle areas are the preferred sampling habitat. To assure comparability between stations sampled, riffle habitats with similar physical features should be selected. This must at a minimum include, substrate size, current velocity, depth and percent overhead canopy. Benthic macroinvertebrates are captured from rock substrates (small boulder and cobble) in riffle areas using a 8"x18" kick net having a .800-.900 mm mesh size. The kick net is worked side to side and downstream for a 5 minute interval, during which the rock substrate is disturbed upstream. Sampling is confined to the mid-river portion of the riffle. All sampling is conducted during the period June through the first week of September. Macroinvertebrates and debris collected are then placed in a one quart sample jar and preserved with 70% ethyl alcohol containing 125 mg/l rose bengal dye.

When low gradient precludes streams from having riffle areas (e.g. central and southern NJ streams), sampling multiple habitats is required. A multi-habitat sample should consist of organisms taken from instream woody debris (sticks and logs), streambank woody snags, depositional areas containing coarse particulate organic matter, aquatic vascular plants and sand/gravel bottom sediments. These physical habitat characteristics are typical for most wadable streams located in central and southern New Jersey. No time restrictions are required for collecting a multi-habitat sample, and some minimum level of effort is necessary to obtain a representative sample. The sampling typically requires 10 to 15 minutes of effort. Macroinvertebrates are collected similarly to those from riffle areas by placing the kick net downstream of the substrate being disturbed and allowing organisms to drift into the net.

Laboratory Processing:

Laboratory methods which utilize a 100-organism subsample were modified from Hilsenhoff (1982). Alcohol containing the sample is poured through a U.S. No. 30 sieve and the sample is placed in a grided glass baking. Care must be taken to assure the sample is homogenous in the dish to avoid bias. Grided sections (2"x2") are then chosen using random numbers until the first 100 organisms are removed. Organism counts are made using a hand recorder. Sorting is always conducted under good light conditions. This includes a light box under the dish and a overhead lamp. When sorting is complete, the 100-organism samples are placed in vials and retained for future identification. All organism identifications are recorded on macroinvertebrate data sheets.

Physical and Chemical Parameters:

Physical and chemical measurements of existing stream conditions are recorded on physical characterization/water quality field data sheets taken from Plafkin et. al. (1989). Additional notes on the absence and presence of aquatic macrophyte, algae, fish species and other pertinent information should be recorded. When impairment is observed, an impairment assessment sheet taken from Plafkin et. al. (1989) should be filled out.

Habitat Assessment:

A habitat assessment is conducted at every sampling station and all information is recorded on field sheets. Such assessments provide valuable information on probable causes of impairment to instream biota, when water quality parameters do not indicate any limitations. The habitat assessment consists of an evaluation of the following physical features: substrate, channel morphology and streamside cover. Each of these groups are scored and summed to produce a total score which is assigned a habitat quality category; excellent, good, fair or poor.

APPENDIX II

Community Metric Description:

Once taxa from each sample have been identified and counted, various community measures are used to evaluate biological integrity. Community analysis is accomplished by using the following biometrics: 1) total taxa richness, 2) EPT taxa richness, 3) percent dominance, 4) percent EPT and 5) Hilsenhoff biotic index. Community metric criteria have been established for three condition categories of water quality; non-impacted, moderately impacted and severely impacted. Numeric criteria for each condition category were established by characterizing macroinvertebrate community structure and function found in non-impacted and severely impacted stream systems. A description of each biometric used to measure instream biological condition is presented below.

1. Total taxa richness:

This metric is simply a measure of the total number of macroinvertebrate taxa identified from a sample collection. A reduction in taxa richness may indicate a pollutant stressor (organic enrichment, toxics, etc.). Taxa which are least tolerant of environmental change are the first to become absent with increased water degradation.

2. EPT richness:

This metric measures the total number of Ephemeropteran (mayflies), Plecopteran (stoneflies) and Trichopteran (caddisflies) taxa in a sample collection. These aquatic insect groups are very sensitive to pollution induced environmental change, and so their presence or absence is a good indicator of water quality.

3. Biotic Index:

This metric measures the relative tolerance of benthic macroinvertebrates to organic enrichment. Species or families are assigned a score of 0 (intolerant) to 10 (tolerant) Hilsenhoff (1982,1988) and Bode (1988). Additional tolerance values for macroinvertebrates not listed in Hilsenhoff (1982,1988) and Bode (1988) are included in Appendix IV. The biotic index is calculated by multiplying the number of each species by their assigned tolerance score, summing these, and then dividing by the total number of individuals in the sample. The biotic index was designed to measure impairment resulting from organic waste loading rather than inorganic inputs (e.g. heavy metals or other toxic substances), so caution should be exercised when applying this index.

4. Percent Dominance:

This metric measures relative balance within the macroinvertebrate community. Healthy communities are characterized by a diverse number of relatively intolerant taxa comprised of different functional groups having abundances somewhat proportional to each other. As a system becomes degraded, certain taxa or taxa assemblages most tolerant of the perturbation become abundant, while intolerant taxa and certain functional groups become reduced. For example, an increased abundance of intermediate tolerant filter feeders is often associated with increased organic enrichment resulting from some organic waste load. Dominance may also provide an endpoint to measure impairment caused by toxics. For example, certain taxa within the Chironomidae family become abundant relative to EPT when concentrations of heavy metals increase (Clements et. al. 1988).

5. Percent EPT:

This metric provides a good measure of numeric abundance for three sensitive groups of aquatic insects. A good representation of mayflies, stoneflies and caddisflies is usually associated with good water quality. Abundances of taxa within these groups often decreases with only subtle environmental changes caused by organic and/or toxic pollutants.

APPENDIX III

Scoring Criteria for Rapid Bipassessments^a

	Non-Impacted	Moderately Impacted	Severely Impacted
	<u>6</u>	<u>3</u>	<u>0</u>
1. Total Families	>10	10-6	4-0
2. EPT Families - northern, NJ	>5	5-3	2-0
central and southern, NJ	>4	4-2	1-0
3. Percent Dominance	<40	40-60	60
4. Percent EPT*	>35	35-10	10
5. Hilsenhoff Biotic Index	0-4	4-6	6-10

Biological Condition

Total Score

Non-impacted	24-30
Moderately impacted	9-21
Severely impacted	0-6

Condition Category

Non-impacted: Benthic community comparable to other undisturbed streams within the region. A community characterized by a maximum taxa richness, balanced taxa groups and good representation of intolerant individuals.

Moderately impacted: Macroinvertebrate richness is reduced, in particular EPT taxa. Taxa composition changes result in reduced community balance and intolerant taxa become absent.

Severely impacted: A dramatic change in the benthic community has occurred. Macroinvertebrates are dominated by a few taxa which are very abundant. Tolerant taxa are the only individuals present.

a - Based on 100 organism subsamples

* Not including the Hydropsyehid family

APPENDIX IV

BIOTIC INDEX TOLERANCE VALUES FOR MACROINVERTEBRATES NOT LISTED IN BODE (1988) AND HILSENHOFF (1987)

Plecoptera	
Peltoperlidae	1
Trichoptera	
Calamoceratidae	0
Coleoptera	
Gyrinidae	8
Hydrophilidae	5
Diptera	
Culicidae	6
Chaoboridae	5
Stratiomyidae	7
Gastropoda	
	7
Oligochaeta	
Naididae	8
Tubificidae	8
Aelosomatidae	9
Lumbriculidae	8
Hirundinea	
	8
Nematoda	
	5
0-3	Intolerant
4-6	Intermediate Tolerance
7-10	Tolerant

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